Statistics Rules

- Pearson's correlation coefficient:

$$r = \frac{n\Sigma xy - \Sigma x \times \Sigma y}{\sqrt{n\Sigma x^2 - (\Sigma x)^2}\ \sqrt{n\Sigma y^2 - (\Sigma y)^2}}$$

- Spearman's rank correlation Coefficient:

$$r = 1 - \frac{6\Sigma D^2}{n(n^2 - 1)}$$

Regression line equation:

$$\hat{y} = a + b\,x$$

where b is the regression coefficient of y on x.

$$, b = \frac{n\Sigma xy - \Sigma x \times \Sigma y}{n\Sigma x^2 - (\Sigma x)^2} \quad , a = \frac{\Sigma y - b\Sigma x}{n}$$

- The regression line equation of y on x is used for predicting the value of y if the value of x is Known also in identifying the error which can be identified by the relation

Error = | table value – the value satisfying the equation |

The correlation is a relation between 2 variables or more.

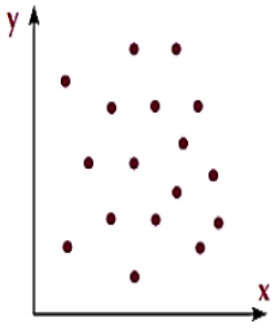


Figure 1
There is no correlation

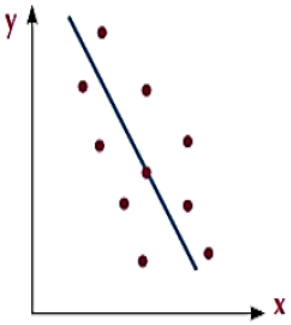


Figure 2
There is an inverse linear correlation

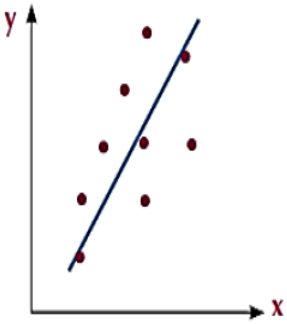
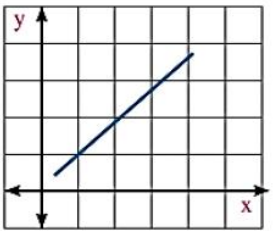
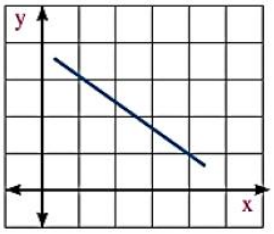


Figure 3
There is a direct linear correlation



perfect direct correlation



perfect inverse correlation

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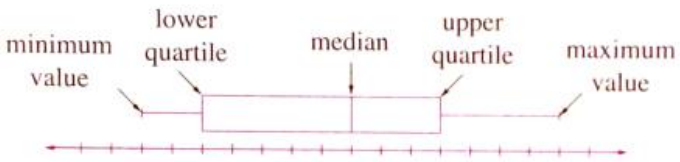
Representation by using box and whisker plot



$$\text{Semi - interquartile range} = \frac{\text{upper quartile} - \text{lower quartile}}{2}$$

Range – Mean – Mode – Median

- The range of set of values = The maximum value - The minimum value
- The arithmetic mean of set of values = $\frac{\text{The sum of all values}}{\text{The number of these values}}$
- The mode : It is the most frequently occuring value.
- The median : It is the value that exists in the middle of the values after arranging them.

probability:

- If A and B two events, then:

$P(A \cup B) = B(A) + P(B) - P(A \cap B)$

$P(A - B) = P(A) - P(A \cap B)$

$P(B') = 1 - P(B)$

- If A and B are two mutually exclusive events, then:

$A \cap B = \phi$, $P(A \cap B) = 0$

- Conditional probability:

If S the sample space of a random experiment, A and B are two events of this space, then the probability of occurring the event A in condition of occurring the event B

$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$ where $P(B) > 0$

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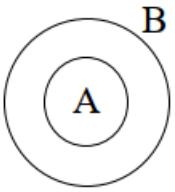
5) $P(A)+P(A')=1$

$\therefore P(A')=1-P(A)$ *also* $P(A)=1-P(A')$

6) $P(A' \cap B')=P(A \cup B)'=1-P(A \cup B)$

8) $P(A \cap B')=P(A-B)$

9) If $A \subset B$, then $A \cup B=B$, $A \cap B=A$, $A-B=\phi$



$P(A \cap B)=P(A)$, $P(A \cup B)=P(B)$

$P(A-B)=0$, $P(B-A)=P(B)-P(A)$

- The two independent events:

It is said that the two events A and B are independent events if and only if

$P(A \cap B) = P(A) \times P(B)$

Random variables:

- The probability distribution of a discrete random variable

x_r	x_1	x_2	x_3	.....	x_n
$f(x_r)$	$f(x_1)$	$f(x_2)$	$f(x_3)$	.....	$f(x_n)$

1- $f(x_r) \geqslant 0$ for each $r = 1, 2, 3, ..., n$

2- $f(x_1) + f(x_2) + f(x_3) + ... + f(x_n) = 1$

- Expectation (Mean) $(\mu) = \sum_{r=1}^{n} x_r \times f(x_r)$

- Variance : $\sigma^2 = \sum_{r=1}^{n} x^2_r \times f(x_r) - \mu^2$

- Standard deviation: σ = Positive Square root of the variance

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- Coefficient of variation $= \frac{\sigma}{\mu} \times 100\ \%$

Geometric probability distribution function

If $X \sim G(S)$ then

$$P(X = n) = S(1 - S)^{n-1} \qquad n = 1, 2, 3, ...$$

Where S is the probability of success, n is the number of trails until reach to the first success

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Expectation and variance of geometric distribution

Mean (expectation)	μ	$= \frac{1}{S}$
Variance	σ^2	$= \frac{1 - S}{S^2}$
Standard deviation	σ	= the positive square root of the variance

Probability distribution of a binomial random variable

If $X \sim B(n, S)$ then

$P(X = r) = {}^{n}C_{r} \times S^{r} \times (1 - S)^{n - r}$, $r = 1, 2, 3, \ldots n$

n: number of trails in the experiment

S:probability of success in each trail

r :is the number of trails (required number)

Expectation and variance of binomial distribution

If X is a random variable $X \sim B(n, S)$

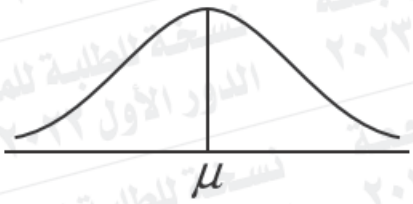
Mean (expectation) $\mu = n \times S$

Variance $\sigma^2 = n \times S \times (1 - S)$

Standard deviation σ = the positive square root of the variance

Where n is the number of trails in the experiment, S is the probability of success in each trail

Normal distribution:



1- The area of the region under the normal curve and above the x axis equals 1.

2- From symmetry, we find that the straight line $x = \mu$ divides the area under the curve and above the x - axis into two regions, the area of each region = 0.5

- To convert a normal distribution into the standard normal distribution we use the relation:

$$Z = \frac{x - \mu}{\sigma}$$

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Estimation Error

When a sample is used to estimate the population mean, the error in the estimate is represented by the symbol E at a confidence level of 1 - α, which is determined by the following relationship: $E = \frac{\sigma}{\sqrt{n}} \times Z_{\frac{\alpha}{2}}$

Where σ is the standard deviation and n is the sample size

Confidence interval for mean population μ

If a random sample of size n is taken from a population that follows a normal distribution with mean μ and variance σ^2

Then $\mu \in]\ \overline{X} - E\ ,\ \overline{X} + E\ [$

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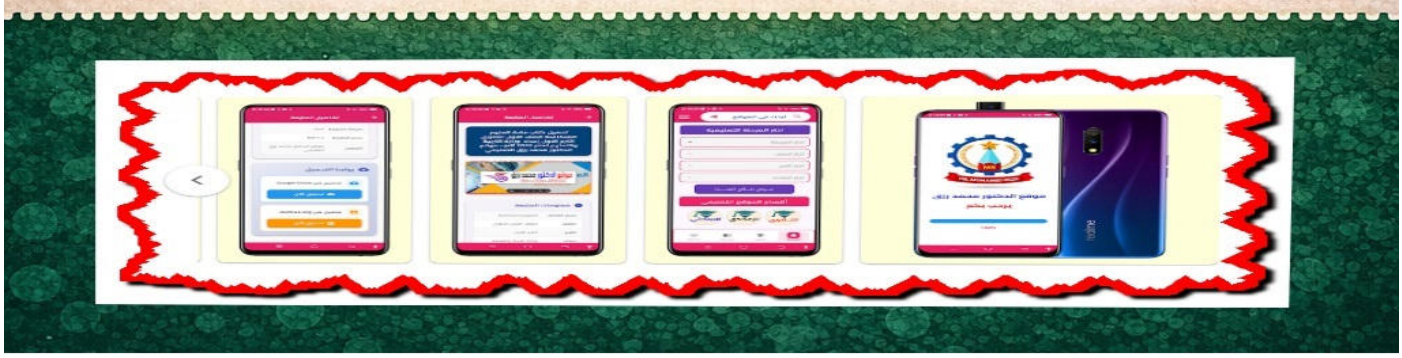

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